Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

STUDIES ON AMERICAN STEPHANOPHIALINAE*

With Two Plates

ERNEST CARROLL FAUST

Since the time of O. F. Müller helminthologists have recognized certain distomes which are characterized by a coronet of papillae around the oral opening. These were first classed as Armata, which group included also all echinostome species. The more modern studies of Looss and Odhner have shown that certain of these species are related to the Allocreadiidae. With *Bunodera luciopercae* (*nodulosa*) as the type Looss (1902:453) proposed the subfamily Bunoderinae for the then known forms, *Crepidostomum metoecus*, *C. farionis* (*laureatum*), *Distomum petalosum* and *Bunodera luciopercae.* However, the enormous extent of the uterus crowding the entire posterior part of the body in the case of Bunodera and the scanty coiling of the uterus entirely anterior to the anterior testis in the case of the other species constitutes so marked a difference that the latter species were necessarily removed from the Bunoderinae. Odhner (1905, 1910) placed them in the Allocreadiinae. Nicoll (1909) showed that they were more closely related to the Allocreadiinae than to the Bunoderinae, but that certain differences possessed by the entire group justified the creation of a new subfamily, Stephanophialinae. The writer's study of the American representatives of this group stands in support of Nicoll's thesis, and contributes certain data which mark out this subfamily more definitely.

The following description supplements Nicoll's original diagnosis. The integument is usually aspinose, but in the case of a few representatives of *Stephaniphiala farionis* (fig. 3) spines are found around the oral sucker. The circumoral papillae are always six in number, altho there is a tendency for the dorsal papillae of Crepidostomum spp. to bifurcate. The yolk glands in this subfamily extend from the region of the pharynx to the posterior end of the body. Moreover, the excretory bladder extends to the anterior border of the anterior testis, whereas in the Bunoderinae it is a small pouch posterior to the testes. In the Allocreadiinae as at present constituted there is no common type of excretory bladder. In the genus Allocreadium it terminates behind the anterior testis.

---

*Contributions from the Zoological Laboratory of the University of Illinois No. 115.

There are recognizable in the subfamily Stephanophialinae three genera, Stephanophiala, Crepidostomum and Acrolichanus. Stephanophiala contains the cosmopolitan species, *S. farionis* (*laureatum*), and a new species, *S. vitelloba*. Crepidostomum contains the type, *C. metoecus*, *C. cornutum* and a new species *C. illinoiense*. Acrolichanus is monotypic, being represented by *A. petalosa*. The type species of the Bunoderinae, *B. luciopercae*, has been found in the North American perch, *Perca flavescens*, by Stafford (1904:489) and also by Lander.

The writer is indebted to Professor Henry B. Ward for valuable data and material, and to Professor Edwin Linton, Professor Henry L. Osborn, Dr. Arthur R. Cooper and the Bureau of Animal Industry of Washington for the loan of material.

Stephanophiala Nicoll 1909

This genus was created by Nicoll in 1909 to separate *Crepidostomum farionis* of Müller (*laureatum* Zeder) from *C. metoecus*. The separation was made on the basis of 1) disposition and number of the oral papillae, 2) position of the genital pore, 3) size of the cirrus pouch, and 4) extent of the uterus with size and number of the ova. These are the characters which require that *Crepidostomum farionis* be placed in a separate genus from *C. metoecus*, but Nicoll's definition of Stephanophiala is obviously obscure and demands more precision on the one hand and more flexibility on the other.

Redesignation of Stephanophiala. Minute to medium-sized Allocread species with six subequal rounded papillae encircling the oral sucker laterally and dorsally. Prepharynx and esophagus short as in the entire subfamily; pharynx about one-half size of the oral sucker. Forking of the gut a little distance in front of acetabulum. Testes median tandem, larger or smaller than acetabulum. Ovary lateral or median. Uterus composed of a few coils between anterior testis and acetabulum, with the vagina leading directly to the genital aperture. Cirrus pouch a muscular S-shaped sac which may lie entirely dorsal to the acetabulum or may extend a short distance behind, but never extending as far caudad as in Crepidostomum. Genital pore always anterior to the forking of the gut. Vitellaria marginal, somewhat dorsal, from the pharynx to posterior end but usually encroaching on the middle field in the region of the testes and farther caudad. Eggs few to many, averaging about 75μ in length by 45μ in trans-section.

In this genus are included *Stephanophiala farionis* (O.F.M.) and new species, *S. vitelloba*, from the Bitter Root Valley, Montana.

Stephanophiala farionis (O. F. Müller)

This species was first described by O. F. Müller in 1788. It has passed thru a vicissitude of generic names including Distoma, Distoma (Crossodera), Crossodera, Lobostome, and Crepidostomum. It has more frequently been known as *laureatum* of Zeder than as *farionis*, altho the former specific designation was not applied until some twelve years after Müller's name *farionis* was proposed. In the Old World the species has been described from Central Europe, Scandinavia, and England. In the Western Hemisphere it has been reported from Canada by Stafford (1904) and Cooper (1915) and from Yellowstone National Park by Linton (1893). Several Salmonidae and Percidae have been described as host of this species.

The writer's material for the study of this species in North America consists of parasites of *Salmo mykiss lewisii*, (Gir.) collected by Linton from Yellowstone National Park and described by him (1893) and, in addition, material collected by Dr. B. H. Ransom, from Park Co., Montana, in 1904, and lent by the Bureau of Animal Industry, Washington, D.C. The study of the New World material shows it to belong to the species *S. farionis*, but it shows likewise that the species is widely variable in several characters.

Detailed descriptions of the worm have been given by Olsson (1878: 24), Blanchard (1891:481) and Nicoll (1909:425) and need not be considered here. However, a summary of the constancy and variability of certain characters may well have a place in this paper. In length the mature worm varies from 1.2 mm. (Ransom material) to 6 mm. (maximum record of Olsson). The ventral sucker is always larger than the oral sucker, altho no constant ratio has been found. The fluke has a short prepharynx, a small pharynx and an esophagus shorter than the pharynx. The gut forks a little distance anterior to the acetabulum. The excretory bladder extends to the anterior border of the anterior testis. The testes are median tandem, somewhat larger than the acetabulum. Anterior to them is the ovary, which may be lateral or median in position. Most variable of all is the size and extent of the cirrus pouch. Its posterior limit in some individuals may be near the center of the acetabulum as Nicoll has found in his material, but in other specimens it extends behind the posterior margin of the acetabulum. In all cases, however, its internal structure is the same, and the anterior end always extends anterior to the genital pore. The amount of coiling of the uterus is variable. The eggs vary in number from few to about one hundred. They vary in size from 62 to 82μ in length and 40 to 59μ in cross section.

The papillose Allocread species have been uniformly described as aspinose. A small per cent of specimens of the Ransom collection have spines on the integument in the region dorsal and lateral to the oral sucker (fig. 3). They are so definite in character as to leave no room for uncertainty. The small number of individuals of this collection so armed makes it inadvisable to consider them as a distinct variety.

The recognition of the American specimens, especially those of Linton and Ransom as *Stephanophiala farionis* shows the wide distribution of this species. The name *S. transmarina* proposed by Nicoll (1909) for the American specimens of this species consequently becomes untenable and is to be considered as a synonym.

Stephanophiala vitelloba nov. spec.

Stephanophiala vitelloba was taken from the gall bladder of a single specimen of *Coregonus williamsoni* Gir. among several dozen examined from the Bitter Root River, at Fort Missoula, Montana, Feb. 18, 1916. Ten specimens were found at the head of the gall duct.

The worm is quite cylindrical, but tapers in an ovoid fashion at the posterior end. At the anterior end there is a slight bending ventrad, so that the oral sucker is directed anteroventrad. Topping the dorsal portion of the oral sucker are six subequal blunt papillae, about 30 μ wide and 20 μ in depth. About one-third of the distance caudad on the ventral side the acetabulum bulges out as a truncate cone. The fluke is 1.11 to 1.4 mm. long by 0.277 mm. wide at the middle of the body. The oral sucker measures 0.148 mm. in trans-section and the acetabulum, 0.176 to 0.185 mm. The integument is free from spines but has small wartose prominences.

The oral atrium leads thru a very short prepharynx into a barrel-shaped pharynx, 74 μ in diameter and about 100 μ in length. At the posterior end of the pharynx is a short esophagus, behind which the digestive tube bifurcates, each cecum clasping the anterior face of the acetabulum and then running caudad to a position near the posterior end of the worm. The wall of each cecum is composed of about eight to ten cells in cross section, with rounded walls lining the lumen of the pouch (fig. 11, *ce*). The cecum is oval in cross section, about 35 μ in frontal diameter and 64 μ along the sagittal plane. The lumen is scarcely as large as the cells of the cecum wall. Each cell is filled with fine granular material and has an oval nucleus 6 μ in section. The general appearance of the cell is vesicular, altho no vacuoles have been found.

The excretory pore is terminal. From it, extending cephalad, near the dorsal face is a long sacculate bladder. It is slightly pouched at the posterior end but soon becomes distinctly tubular. It continues forward as a single tube to the region of the ootype where it bifurcates, sending forward two lateral vessels. Beyond that point the system has not been traced. The bladder has no granular inclusions.

The male genital organs consist of two testes, efferent ducts, muscular cirrus and seminal vesicle. The testes are rounded glands lying one behind the other on the ventral side of the body at the beginning of the posterior half of the body. They measure about 100 μ in diameter. Each testis (fig. 11) contains a great number of spherical cells, arranged almost exactly in concentric rows. The cells are about 6 μ in section. Toward the center of each gland are found various stages of maturation up to spermatids and spermatozoa. The maturing cells occur in large aggregates, so that they form large clumps of densely staining bodies in the gonocoel. From the outer margin of each testis at the anterior end a vas deferens arises. The two efferent ducts proceed separately to the anterior end of the ovary in which region they merge into the posterior end of the cirrus sac. The cirrus is long and muscular. It bends on itself near the middle of the acetabulum and proceeds again forward in the region of the left cecum, ending at the genital pore, anterior to the forking of the ceca. The portion which constitutes the seminal vesicle is located at the S-bend in the sac. Prostate glands occur in the anterior half of the cirrus pouch.

The female genitalia consist of ovary, oviduct, seminal receptacle, Laurer's canal, vitellaria and vitelline ducts, shell gland and uterus. The ovary lies just anterior to the anterior testis, overlapping it in part. It is spherical, lying slightly to the side of the mid-plane (figs. 5, 12, *o*) and measures 110 to 120 μ in diameter. A coil of the uterus lies below it. The immature ovarian cells are similar to those of the testes, but somewhat smaller. The short oviduct proceeds ventrad (fig. 8) where it opens into the ootype. On the left of the ootype is a pyriform receptaculum seminalis and branching from its neck is a tubular sac, Laurer's canal, directed dorsad. It ends blindly near the dorsal wall. On the right hand side is a clump of cells, eight or ten in number, with deeply staining cytoplasm and small spherical nuclei. These constitute the shell glands of authors. Extending lateral right and left from the ootype are the vitelline ducts. Their plane practically divides the animal into equal halves. The vitellaria are the most characteristic features of the fluke. Lateral to the ceca they extend from the extreme anterior to the extreme posterior ends. At the posterior end they bend forward inside the ceca, extending almost to the ootype. In section they appear as distinct chorda, the outer series large and at times divided into branches, while the smaller inner glands constitute a single stem. Each chordum in section is composed of aggregates of vesicular cells of irregular polygonal outline and large spherical nuclei which display great numbers of mitotic figures. The entire cell is rich in chromatic materials.

From the ootype the uterus coils forward, opening to the right of the cirrus sac. It contains from four to eight eggs. The eggs are oval, with a lemon colored shell and operculum at one end. They measure about 77 μ in length by 42 μ in trans-section. The egg is filled with granular cytoplasm and has, in addition, from twelve to twenty-four ovate vitelline cells.

Crepidostomum Braun 1900

This genus was created by Braun (1900) to include the species *Distomum farionis* (*laureatum*) and *D. metoecus*, designating papillose Allocreadine species, which unlike Bunodera, have the uterus confined anterior to the anterior testis. The discovery of other species related to these shows that these Old World species are to be regarded as types of distinct genera. The present study shows the close relationship of *Crepidostomum metoecus*, *C. cornutum*, and *C. illinoiense*. On the basis of a study of these three species a redesignation of the genus follows.

Redesignation of Crepidostomum. Minute to inframedium aspinose Allocreadine species with six oral papillae, of which the ventral pair consist of laterally extending muscular processes which taper to an acute point. Dorsal papillae showing a tendency toward bifurcation. Short prepharynx and esophagus; pharynx minute. Gut forking occurs a little or a considerable distance in front of acetabulum, depending on expansion or contraction of prepharynx and esophagus. Excretory bladder extending to anterior border of anterior testis. Testes median tandem. Ovary lateral or median, just anterior to testes. Vitellaria from pharynx to posterior end. Vitelline follicles sparsely scattered anterior to ootype. Cirrus sac large, muscular, often convoluted, extending from ootype to front of acetabulum. Genital pore ventral or posterior to forking of gut. Uterus consisting of several coils anterior to anterior testis. Eggs one to several, varying in size from 55 by 40.9 μ for *C. metoecus* to 70 by 41 μ for *C. cornutum.* Found in various fishes in North America and in *Vespertilio lasiopterus* in Europe. Young of American species have been found in Cambarus spp.

Crepidostomum cornutum (Osborn) 1903

This species, originally designated as *Bunodera cornuta*, was described from material from *Micropterus dolomieu*, *Ambloplites rupestris*, and *Ameiurus nebulosus*, taken from Chautauqua Lake, New York. It has since been found in Canada by Stafford (1904:490) in the distomulum stage in Cambarus sp. and by Cooper (1915:193) as adults in *Micropterus dolomieu*, *Ambloplites rupestris*, and *Amieurus lacustris* and in the distomulum stage in Cambarus spp.

The material on which the original description is based (Osborn 1903) bears evidence of being not one species but three species, namely, a Crepidostomum species which must be regarded as the *cornutum* type, *Acrolichanus petalosa* (Lander), and a Bunoderan species, probably *luciopercae.* Specimens from Professor Osborn which the writer has been enabled to examine consist of *Crepidostomum cornutum* and *Acrolichanus petalosa.* The fact that the *cornutum* individuals have a muscular cirrus sac and a short uterus coil never encroaching on the territory of the testes or farther caudad precludes any possibility of regarding them as Bunoderans. While figures 1 to 6 of Osborn's paper are acceptable as representatives of *C. cornutum*, fig. 7 is distinctly a Bunoderan. Thus it becomes necessary to redescribe *C. cornutum* and limit the type more definitely.

The size of *C. cornutum* is variable. Its length ranges from 0.9 to 3.0 mm. and its width from 0.2 to 0.9 mm. While it is slightly narrower at the posterior end than in the region of the acetabulum, the tapering is so gradual as to be almost inconspicuous. The oral sucker is commonly as wide as the body or even wider, its diameter varying from 0.33 to

0.46 mm. The acetabulum is considerably smaller, from 0.15 to 0.31 mm. in trans-section. It lies in the anterior quarter of the body.

Of the six papillae crowning the oral sucker the ventral pair are lateral extentsions of the sucker itself, giving the appearance on the whole of turned flanges (fig. 14). The four remaining papillae are equal in size and inconspicuous in detail.

The orifice leads thru a short prepharynx into a small oval pharynx about 50μ in cross section. Behind the pharynx is a short esophagus of equal length. The digestive tract usually bifurcates some little distance in front of the acetabulum. Long tubular ceca extend to near the caudal extremity of the body.

The excretory system as far as it has been made out consists of a long bladder arising from a caudal excretory pore and ending near the anterior border of the anterior testis. The tubules have not been studied.

Turning to the genital organs, large testes, capable of considerable elongation or widening, lie tandem in the posterior half of the body. Osborn (1903:69-71) has described slender vasa deferentia which run from the testes along the dorsal side of the fluke, merging into a single duct at the base of the cirrus sac (fig. 6). From ventral aspect the ovary is seen sometimes on the right, sometimes on the left. It is oval and considerably larger than the receptaculum seminalis. The ootype is located in about the center of the body. Its relation to the female genital organs is shown in Osborn's figure 6. The vitellaria are situated in rather definite chorda, closely surrounding the ceca on the sides. Anterior to the ootype they are composed of minute follicles. They usually extend from the pharynx to the posterior end of the body. They do not encroach on the median field as do the follicles in *C. illinoiense*.

The uterus in the mature worm consists of several coils anterior to the anterior testis, with a terminal portion directed forward over the acetabulum toward the genital pore. The genital pore is ventral or slightly posterior to the bifurcation of the gut. Osborn (1903:72) has found its anterior end to be muscular. The eggs of *C. cornutum* are not nunerous; they range up to about twenty. They measure 65 to 71 μ in length by 41 μ in cross diameter. The cirrus sac is a long coiled muscular organ arising in the region of the ootype. At times its convolutions separate the ovary from the receptaculum seminalis. The writer has found both the vesicle and the ductus ejaculatorius to be extensively muscular. As is commonly found in the Stephanophialinae the ductus is surrounded by prostate glands.

Crepidostomum illinoiense nov. spec.

This minute fluke was taken from the intestine of the crappie, *Pomoxis sparaides* (Lac.), at Havana, Illinois, July 11, 1910, by Dr. H. J. Van Cleave for Professor Henry B. Ward, to whom the writer is indebted for the material. A large number of specimens were secured from the intestine of the host.

The worm is elongate in outline, with a greatest width of 0.15 to 0.18 mm. in the region of the acetabulum, posterior to which it gradually tapers to a distinctly conical end. The acetabulum measures from 76 to 88μ in trans-section, while the oral sucker is almost twice as large. Crowning the oral sucker is a cluster of six papillae, two ventral, two dorsolateral and two distinctly dorsal (fig. 17). The ventral papillae emerge from the sides of the posterior margin of the oral sucker, but are always intimately connected with an anterior folding of the sucker. Each papilla extends laterad about 15μ then is flexed dorsad some 5 to 7μ, terminating in a distinct point. The dorsolateral papillae are triangular with rounded corners. They extend forward and dorsad. The dorsal papillae lie directly above the orifice. They are separated from one another by an inconspicuous sinus. Each dorsal papilla is bifurcate, altho the notch is not deep. Altho there is no fundamental muscular connection between the dorsal and the dorso-lateral papillae, folds of the integument stretch across the intervening notch, giving the appearance superficially of a sympapillose condition. The body is unarmed.

The mouth opens thru a short prepharynx into a spherical pharynx of 26μ diameter. Behind this organ is an esophagus of equal length. The bifurcation of the digestive tract occurs just a little anterior to the acetabulum. The ceca are long attenuate tubes reaching to the extreme posterior limits of the worm.

The excretory system (fig. 19) was found only in sections. The pore is caudal in position. For a short distance forward the bladder is muscular, but as it bends dorsad its lining is entirely parenchymatous. The tube gradually becomes more and more attenuate in the vicinity of the testes and ends just dorsal to the anterior wall of the anterior testis.

The ovary is a medium-sized reniform body lying just behind the acetabulum. In ventral view it is covered on the right side by the cirrus pouch and on the left by the uterus. In a median line just behind the ovary lies the ootype, and on the right, posterior to the ootype, is a large pyriform receptaculum seminalis. The testes lie tandem in the third quarter of the body. The anterior one is sometimes compressed longitudinally so that it reaches laterad almost to the ceca. The cirrus pouch is an extremely long muscular organ, originating some distance posterior to the ootype and extending forward over the acetabulum to terminate at the genital pore, ventral to the forking of the gut. It is capable of considerable eversion. The vitelline glands at the margins of the body extend from pharynx to posterior end of the body. Anterior to the acetabulum they are few and small. In the region of the testes they encroach on the median organs and fill the entire dorsal portion of the worm posterior to the testes. The uterus is an uncoiled tube which runs directly to the genital pore. The eggs occur singly or at most in pairs. The mature egg measures 63 by 40 μ. The shell of the immature egg is colorless, while the yolk follicles are yellow; the shell of the mature egg is a dark golden yellow, concealing the color of the yolk material.

Acrolichanus Ward 1918

The name Acrolichanus was substituted by Ward (1918:396) to replace Acrodactyla of Stafford 1904, preoccupied. The genus at the present time includes a single species, first described by Looss (1902:454) as *Distomum petalosum* Lander. The type material was secured from the Lake sturgeon, *Acipenser rubicundus* Le S., from the vicinity of Ann Arbor, Michigan. The species has also been found by Stafford (1904) and Cooper (1915:194, 195) in the same host in Canadian waters. It is highly probable that *Distomum auriculatum* Wedl (?) of Linton (1898: 491) and *Bunodera lintoni* Pratt (Linton 1901:435) are synonyms of *Acrolichanus petalosà.* The type *D. auriculatum* Wedl, described from Europe as a parasite of *Acipenser ruthendus* (Wedl 1857:242, 243) is so inadequately described that it seems unwise to give it a systematic position.

Redesignation of Acrolichanus. Inframedium Stephaliphialine species with six oral papillae, of which the ventral pair is draped over the anterior end of the oral sucker. Excretory bladder dilated with conspicuous constriction at posterior end. Testes median tandem or slightly oblique. Ovary close behind acetabulum; vitellaria composed of sparsely scattered follicles. Cirrus sac ending in a large conspicuous sphincter.

Acrolichanus petalosa (Lander) 1902

Acrolichanus petalosa has been referred to frequently in the literature but has never been adequately described. The writer has had access to material and records of this species from the following sources: 1) original drawings of Lander's type material, 2) drawings made by Professor Henry B. Ward of material secured from Cambarus sp., at Ann Arbor, Mich., 1893 (Ward 1894:180), 3) material on which Cooper's record (1915) is based, and 4) specimens of Osborn's material from *Ambloplites rupestris*.

A. petalosa is inframedium in size, averaging from 1.5 to 2.5 mm. in length and 0.32 to 0.54 mm. in width. The acetabulum lies at the posterior limit of the anterior third of the body. It measures 0.16 to 0.32 mm. in cross section. The oral sucker measures from 0.27 to 0.45 mm. The body is aspinose. The disposition of the oral papillae as seen from the front and below is strikingly similar to a notched geranium leaf. The six lobes are practically equal; the ventrals are directed caudad and their folds continue mesad so that they meet in an acute notch just under the oral sucker (fig. 20). A very short prepharynx leads into a pharynx which is at times oval but is more often campanulate. A short esophagus bends dorsad from the pharynx (fig. 21), so that the ceca frequently appear to airse from the base of the pharynx. The ceca originate some little distance anterior to the acetabulum and extend as large pouches to the subcaudal region of the worm. The cells of the ceca are small, from ten to fourteen being found in a cross section.

The excretory bladder arises posteriorly from an inconspicuous caudal pore. For a short distance it consists of a small tube, but soon enlarges into an irregular pouch lined with a thin layer of cells (fig. 26). The pouch ends at the anterior margin of the anterior testis, from which region a pair of lateral tubes can be traced forward for a short distance in preserved specimens. The writer is indebted to Professor Henry B. Ward for Lander's data regarding the details of the tubule system. From the sides of the anterior extremity of the bladder a pair of single tubules arises. Each tubule soon bifurcates, one branch coursing forward and the other caudad. Capillaries ending in flame cells arise along each lateral tubule. As many as six flame cells have been found anterior to the forking of the system, while eight have been found posterior to this separation. The anterior limit of the system is in the region of the pharynx.

The ovary, a medium-sized ovoid gland, is usually located lateral to the median line, immediately behind the acetabulum. The receptaculum seminalis is very minute. The testes are large ovate organs, lying in the third or fourth quarter of the body. The ootype is median, just behind the ovary. Laurer's canal which is on the left (fig. 25) meets the duct from the receptaculum seminalis and both open into the ootype from above (fig. 27). The sparsely scattered vitellaria extend from the pharynx to near the posterior end of the body. Their transverse ducts empty into the ootype from a ventrolateral direction.

The uterus emerges from the posterior margin of the ootype. After coiling once it runs forwards to the right of the acetabulum to the genital pore. The eggs are few to several in number, averaging up to twenty-five in some cases. Each egg measures 70 to 72 μ in length by 40 to 50 μ in cross section. The operculum is small but distinct (fig. 23). As in the eggs of the other Stephanophialinae, many yolk cells are found. The small efferent ducts from the testes converge in the plane of the ovary. The muscular cirrus sac begins at this junction. It is daucine in shape, except for a lateral bulge in the portion dorsal to the acetabulum. This bulge is due to the convolution of the seminal vesicle which occupies the middle region of the cirrus sac. The ductus ejaculatorius is conspicuously muscular. Both the seminal vesicle and the ductus are supplied with glands. The opening of the ductus lies posterior to the forking of the gut. It is provided with a powerful sphincter (fig. 27).

The structure of the oral papillae is of a deep-seated character. It is made up of an outermost basement membrane, within which are several enveloping muscle strands, the nuclei of which can be made out plainly (fig. 28). Within the center of the papilla is a core of longitudinal muscle strands. Both of these series are distinct from those making up the oral sucker.

The main features of the worm are made out in very young distomula (fig. 29). These include the campanulate pharynx, distinct genital cells, representing testes, ovary and anterior sphincter of cirrus sac, sparsely scattered vitellaria, and the constriction of the excretory bladder at the posterior end. Eyespots are also present in young worms.

KEY TO THE SUB-FAMILY STEPHANOPHIALINAE

1 (4) Cirrus pouch small to inframedium, mostly lying over the acetabulum; genital pore anterior to the forking of the gut; papillae subequal . . . . Stephanophiala 2
2 (3) Oral sucker smaller than acetabulum; testes larger than acetabulum; eggs few to many, varying in size from 62 to 85μ by 40 to 59μ; integument occasionally spinose . . . . *S. farionis* (O. F. M.)
3 (2) Oral sucker smaller than acetabulum; testes smaller than acetabulum; eggs few, 77μ by 42μ . . . . *S. vitelloba* Faust
4 (1) Cirrus pouch large, extending some distance behind the posterior limit of the acetabulum; genital pore posterior or ventral to the forking of the gut; ventral papillae large, differentiated 5
5(10) Ventral papillae extending laterad, tapering to acute points; cirrus pouch well developed, muscular, tapering to a small ductus ejaculatorius . . . . Crepidostomum 6
6 (7) Dorsal papillae entire, not tending to bifurcate; pharynx very small . . . . *C. cornutum* (Osborn)
7 (6) Dorsal papillae tending to bifurcate; pharynx about one-half diameter of oral sucker. 8
8 (9) Inframedium in size, testes very large . . . . *C. metoecus* Braun
9 (8) Minute, testes relatively small . . . . *C. illinoiense* Faust
10(5) Ventral papillae extending as folds over the anterior portion of the oral cavity; ductus ejaculatorius with a powerfully muscular end . . . Acrolichanus
Single species . . . . *A. petalosa* (Lander)

Biology of the Stephanophialinae

While no faunistic-biological reconnoissance of the Stephanophialinae will be attempted in this paper on account of the incompleteness of many of the records, the data are nevertheless sufficiently adequate to indicate some of the important biological relations of the group.

With the exception of *Crepidostomum metoecus* Braun all of the described species are parasites of fresh-water fishes. *Stephanophiala farionis* (O.F.M.), the species most widely distributed geographically, has also the greatest host distribution. European investigators have reported it from *Trutta fario* (L.), *T. trutta* (L.), *Epitomynis salvelinus* (L.), *Thymallus thymallus* (L.), and *Coregonus oxyrhinchus* (L.), while American students have found it in *Salvelinus fontinalis* Mitch., *Perca flavescens* (Mitch.), *Eupomotis gibbosus* (L.), *Boleosoma nigrum* (Raf.), *Etheostoma iowae* J. and M., *Stizostedion vitreum* (Mitch.), and *Salmo mykiss lewisii* (Gir.). In addition Stafford (1904:490) has reported this species from *Necturus maculatus*. *Crepidostomum cornutum* (Osborn), while limited to the Eastern part of the United States and Canada, has been found in *Micropterus dolomieu* Lac., *Ambloplites rupestris* (Raf.), *Ameiurus lacustris* (Walb.), and *A. nebulosus* (Le S.). *Acrolichanus petalosa* (Lander) has been found in various localities in the Great Lakes and St. Lawrence Basin, in each case from the same species of host, *Acipenser rubicundus* Le S. The species described as new in this paper, *Stephanophiala vitelloba* and *Crepidostomum illinoiense*, have each been found in but a single host in a single locality.

The normal seat of these parasites is the anterior part of the small intestine, altho they have been recorded from the posterior end of the intestine, the pyloric ceca, the gall bladder, and the stomach. It is also a matter of record that the related species *Bunodera luciopercae* (O.F.M.) has wandered out of its host after the death of the latter.

Sufficient data are not at hand to determine annual cycles of infection in the host.

The life history of no one of the species of the Stephanophialinae has been worked out. That there is an intermediate host is a certainty, since immature specimens of *Crepidostomum cornutum* and *Acrolichanus petalosa* have been found in abundance in the crawfish, and cysts of immature *Stephanophiala farionis* have been taken from Hexagenia sp. But the type of cercaria is not known. However, since the cercaria of the near relative, *Allocreadium isoporum*, is a rhopalocercous type and the precocious Allocread species, *Cercaria macrostoma* Faust, is a cystocercous type, it is highly probable that the Stephanophialine species have cercariae that are provided with heavy tails. It is evident that the cercariae have pigmented eyes, since representative species of all three genera of this group show the remains of these eyes in their immature stages. Moreover, since the miracidium of *Bunodera luciopercae* has pigment eye-spots, it is possible that the miracidia of the Stephanophialinae are also pigmented.

A tentative life history scheme for the various species of Stephanophialinae may be outlined as follows:

$$\text{miracidium-}>\underbrace{\begin{array}{c}\text{sporocyst-}\\ \text{or}\\ \text{redia}\end{array}>\begin{array}{c}\text{cercaria-}\\ \text{with heavy}\\ \text{tail and}\\ \text{eye-spots}\end{array}}_{\text{in snail}}>\underbrace{\text{distomulum-}}_{\begin{array}{c}\text{in insect}\\ \text{or}\\ \text{crustacean}\end{array}}>\underbrace{\text{adult distome}}_{\begin{array}{l}\text{in fresh water}\\ \text{fishes (exception-}\\ \text{ally in other ver-}\\ \text{tebrates)}\end{array}}$$

IMPORTANT REFERENCES

Blanchard, R.
1891. Notices Helminthologiques. Mem. Soc. zool., France, 4:420-489; 38 figs.

Braun, M.
1900. Trematoden der Chiroptera. Ann. d. K. K. Naturhist. Hof-mus., 15; 217-236; 1 Taf.

Cooper, A. R.
1915. Trematodes from Marine and Fresh-Water Fishes. Trans. R. Soc. Canada, (3)9:181-205; 3 pl.

Linton, E.
1893. On Fish Entozoa from Yellowstone National Park. Rept. U. S. Com. of Fish and Fisheries, 1889-1891:545-564; 5 pl.
1898. Trematode Parasites of Fishes. Proc. Nat. Mus., 20:507-548; 15 pl.
1901. Parasites of Fishes of the Woods Hole Region. Bull. U. S. Fish Com. for 1899:405-492; 34 pl.

Looss, A.
1902. Ueber neue und bekannte Trematoden aus Seeschildkröten. Nebst Eröterungen zur Systematik und Nomenclatur. Zool. Jahrb., Syst., 16: 411-894; 12 Taf.

Müller, O. F.
1788. Zoologica danica. 4 vol. in 2. Havniae. 225 pp., 160 pl.

Nicoll, Wm.
1909. Studies on the Structure and Classification of Digenetic Trematodes. Quar. Jour. Micr. Sci., n.s., 53:391-487; 2 pl.

Odhner, T.
1905. Die Trematoden des Arktischen Gebietes. Fauna Arctica, 4:291-372; 3 Taf.
1910. Nordostafrikanische Trematoden. Fascioliden. Results Swedish Zool. Exp., 1901. Stockholm. 170 pp.; 6 Taf.

Olsson, P.
1876. Bidrag till Skandinaviens Helminthfauna. Stockholm. 35 pp.; 4 Taf.

Osborn, H. L.
1903. Bunodera cornuta sp. nov.: a New Parasite from the Crayfish and Certain Fishes of Lake Chautauqua, N. Y. Biol. Bull., 5:63-73; 7 figs.

Stafford, J.
1904. Trematodes from Canadian Fishes. 1. Zool. Anz., 27:481-495.
Ward, H. B.
1894. On the Parasites of the Lake Fish. Proc. Am. Micr. Soc., 15:173-182, 1 pl.
1918. Parasitic Flatworms, in Ward and Whipple's Fresh-Water Biology, 365-453, 113 textfigs.
Wedl, C.
1857. Anatomische Beobachtungen über Trematoden. Sitz. K. Akad. Wiss., Wien. Math.-naturwiss., 26:241-278, 4 Taf.

EXPLANATION OF FIGURES

c	cirrus pouch	s	shell gland
ce	cecum	t_1, t_2	anterior and posterior testes
d	vitelline duct	u	uterus
e	egg	v	vitellaria
g	genital pore	vd	vas deferens
l	Laurer's canal	vs	seminal vesicle
o	ovary	x	excretory bladder
p	pharynx	y	ootype
r	receptaculum seminalis		

DESCRIPTION OF FIGURES

PLATE XIV

Stephanophiala farionis. 1.—Ventral view, × 54; 2.—lateral view of oral sucker and papillae, × 105; 3.—detail of portion of integument lateral to acetabulum, showing spines, × 180; 4.—egg, × 180.

Stephanophiala vitelloba. 5.—Dorsal view, × 54; 6.—dorsal view of head, showing papillae, × 105; 7.—egg, × 240; 8.—detail of sex organs in region of ootype, × 180; 9.—cross section of worm just anterior to acetabulum, × 180; 10.—cross section thru ovary, × 180; 11.—cross section thru posterior testis, × 180; 12.—cross section thru region of ootype, × 180; 13.—detail of lateral papilla, × 180.

PLATE XV

Crepidostomum cornutum. 14.—Ventral view, × 34; 15.—detail of anterior end, × 24.

Crepidostomum illinoiensis. 16.—Ventral view, × 105; 17.—detail of anterior end, ventral view, × 180; 18.—egg, X 330; 19.—diagram of lateral aspect, × 75.

Acrolichanus petalosa. 20.—Ventral view, × 34; 21.—median sagittal section, × 34; 22.—detail of anterior end, × 24; 23.—egg, × 330; 24.—cross section thru region of genital pore, × 75; 25.—cross section thru region of ootype, × 75; 26.—cross section thru anterior testis, × 75; 27.—detail of genital organs, × 50; 28.—section thru lateral papilla, × 105; 29.—ventral view of young fluke, × 34.

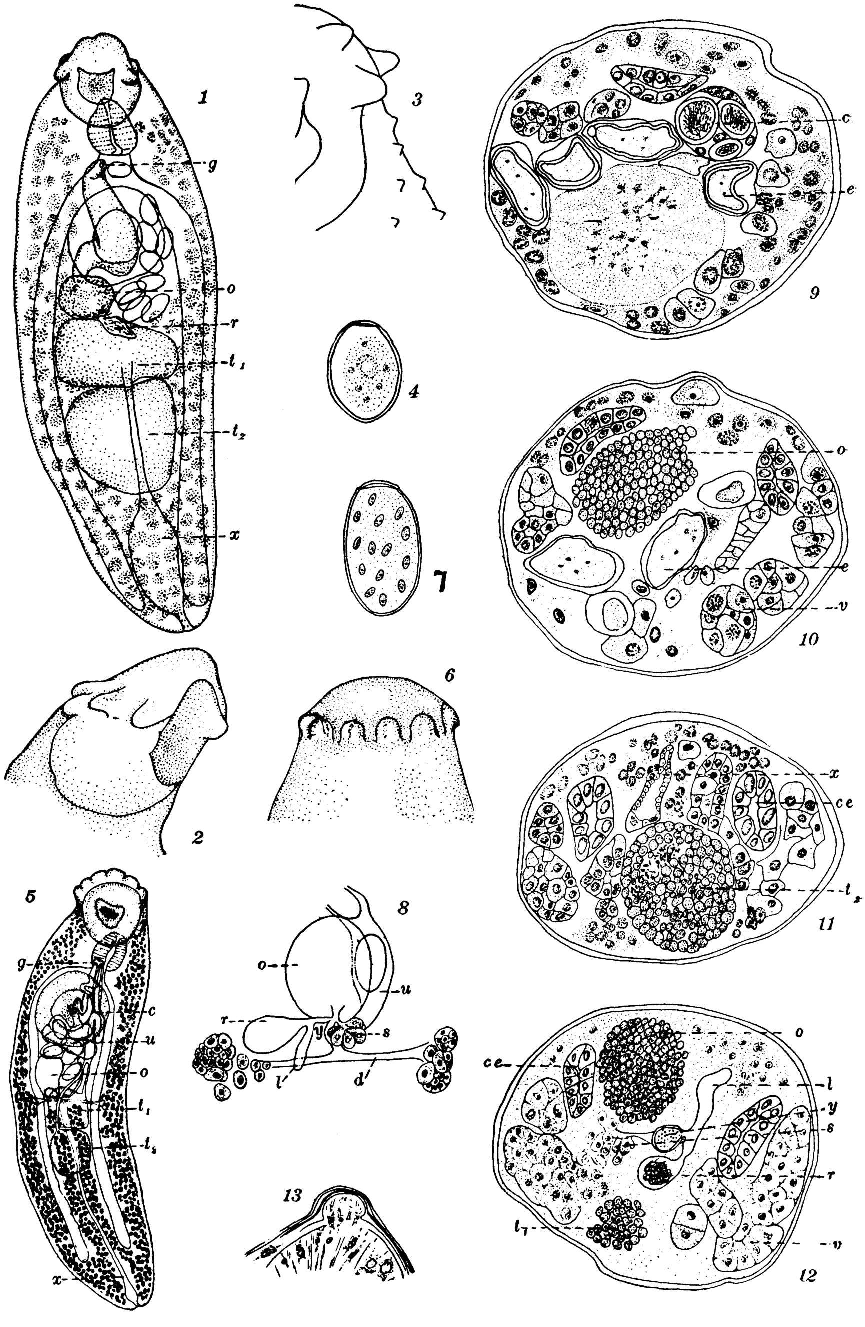

PLATE XIV

FAUST

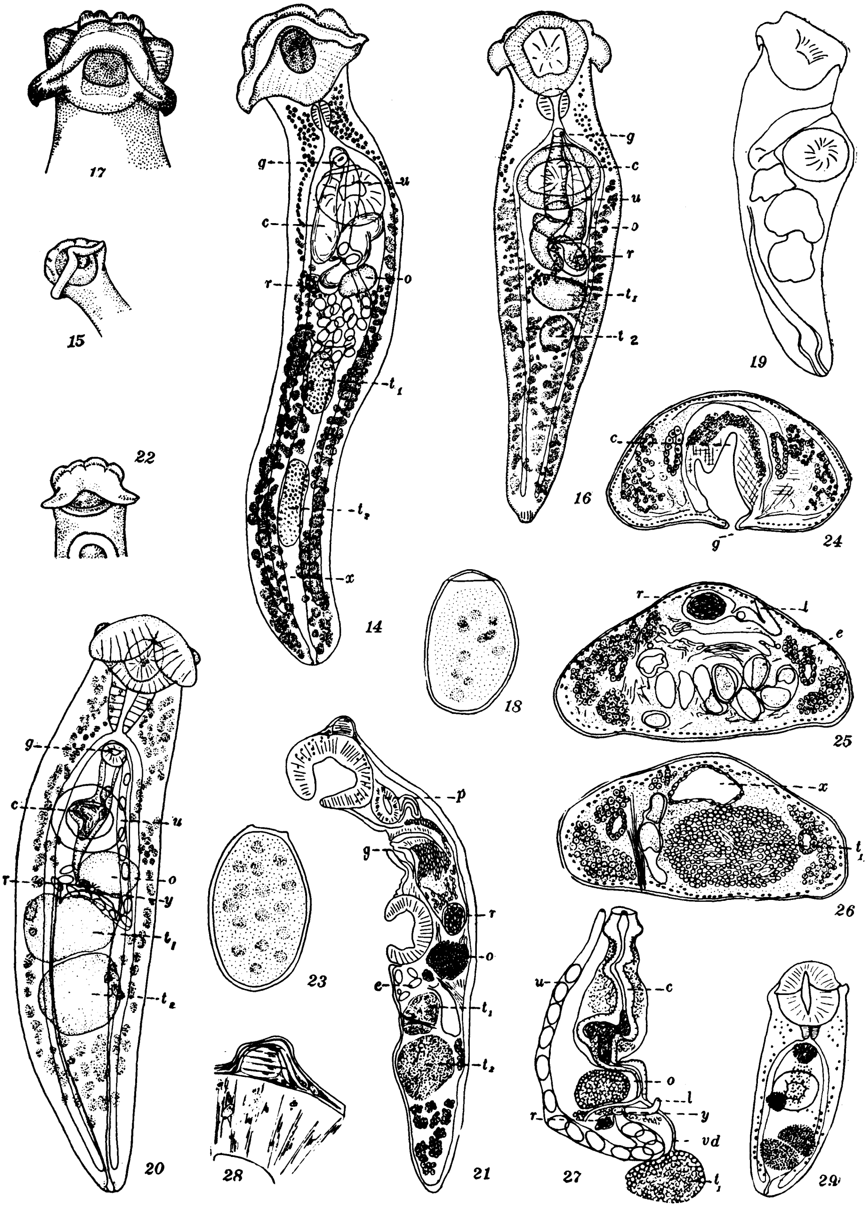

PLATE XV

FAUST